Cooktownia robertsii, a remarkable new genus and species of Orchidaceae from Australia

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Summary

Jones D.L. (1997). *Cooktownia robertsii,* a remarkable new genus and species of Orchidaceae from Australia, *Cooktownia robertsii* D.L. Jones is described from Queensland. *Austrobaileya* 5(1): 71–78.

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Introduction

Identification of the genus of an unfamiliar species of orchid becomes relatively straight forward with some experience. The generic placement of an extremely unusual terrestrial orchid recently collected in northeastern Queensland, however, has caused considerable difficulty. Embryological studies (Clements pers. comm.) show that the species has similar developmental stages to orchids of the subfamily Orchidoideae, tribe Orchideae (Abe 1972; Fredrikson 1991; Clements 1995). The elongated, somewhat fusiform, asymmetric ovaries, the shape and arrangement of the sepals and petals and the shape of the elements of the column are consistent with this placement. However the paired, broadly ovate, ground-hugging leaves and the thin wiry scape are very different from any Orchidoid species which has been described from the region. The labellum, which is entire, lacks a basal spur, usually considered to be a feature of orchids of this type, but Dressler (1993) notes that a spur may be lacking in some species.

Examination of the flowers of this novelty shows that the column is much modified and would appear to be non-functional. Elements of the anther and stigma occur as simple rod-like analogues (Fig 1.1). The anther analogue can be recognised by its dorsal placement opposite the labellum (Fig. 1.3 & 1.4) and the presence on its lateral surfaces of aggregates of structures which resemble pollen tetrads (Fig. 1.5, 1.6). Two or four rod-like structures anterior to the anther analogue are apparently much modified stigmas (Fig. 1.2) and/or rostellar arms (for developmental studies in Orchidoid species see Kurzweil 1987). Thus although the flowers of this enigmatic species appear to be superficially normal, the column is much modified and its elements would appear at first sight to be non-functional, lacking pollen and receptive stigmata. Despite these significant reproductive limitations the species is common over a localised natural area and is maintaining a viable population level (L.Roberts pers. comm., C.Broers pers. comm.). Examination of mature ovaries shows that they contain reproductive structures which have an appearance remarkably similar to normal Orchidoid seed (Fig. 2).

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Subtribal Placement

The subtribal classification of the Orchideae is difficult and well beyond the scope of this paper. A brief consideration of the subject is necessary since the subtribal characters influence the generic choices for the taxon in question. Dressler (1993) recognised two subtribes within the Orchideae, the Habenariinae and Orchidinae, and at the same time noted that the distinction between them needs reevaluation. In Orchidinae, according to Richard (1818) and Dressler (1993), the

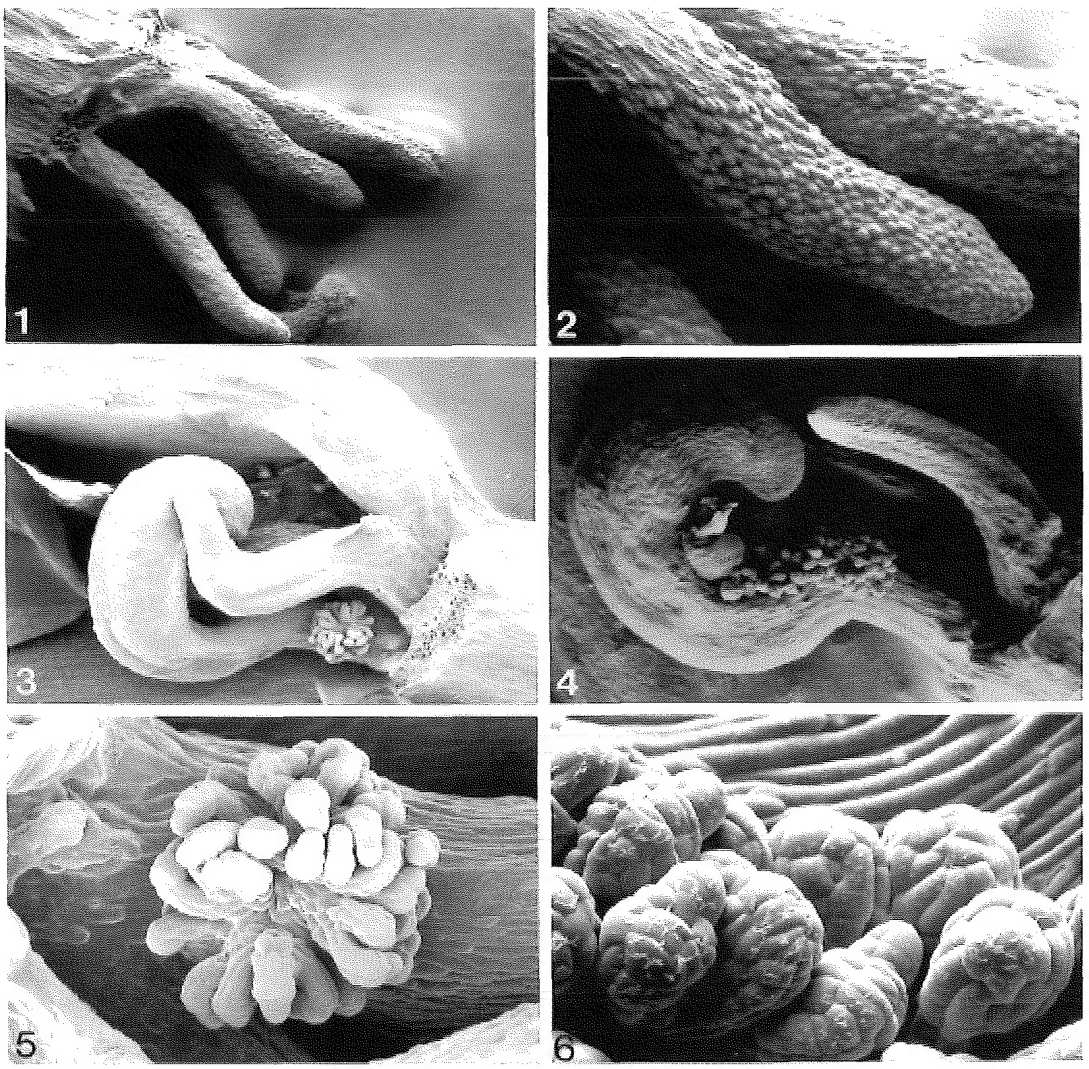

Fig. 1. Scanning electron micrographs of *Cooktownia robertsii*. 1.1. column elements from side (x 36); 1.2. surface structure of stigma analogue (x 100); 1.3 & 1.4 anther analogues from two flowers (x 40); 1.5. site of development of abortive pollen structures (x 165); 1.6. abortive pollen structures (x 430).

columns have a concave stigma, whereas those in Habenariinae have convex, long-stalked stigmas, long rostellar arms and long caudicles (Senghas 1973; Dressler 1993). These characters are not all clear cut as Kurzweil & Weber (1991) found that the stigmas of the Orchidinae are usually convex or pad-like. Linder & Williamson (1986) note that these stigmatic characters are difficult to observe, and in my view they are also subjective and difficult to interpret. Certainly undue emphasis has been placed on features of the gynostemium in much of this generic classification, resulting in considerable overlap and confusion.

Based on the gynostemium characters, the subtribal placement of the taxon under study is equivocal. Although abortive, the shape of

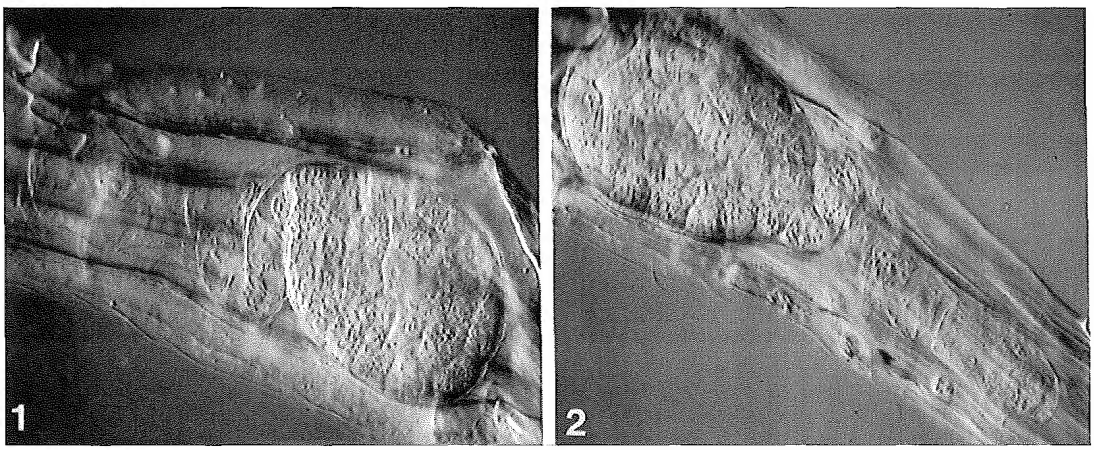

Fig. 2. 2.1 & 2.2. Mature seed-like structures of *Cooktownia robertsii* showing proembryo and supensor (x 35).

the stigma analogues could be considered to be flat to concave and thus consistent with a member of the Orchidinae. Alternatively their elongated shape could place them in the Habenariinae. Because of this subtribal uncertainty, the generic placement of the new species is also uncertain. *Dressler* (1993) enumerates 34 genera in the subtribe Orchidinae and 23 in the Habenariinae. Several authors (Linder & Williamson 1986, Kurzweil & Weber 1991, Dressler 1993) mention problems in the generic classification of the Orchideae. Even a brief examination of the literature reveals conflicting and confusing views on generic delimitation and characterisation (see for example Ames 1910; Luer 1975; Seidenfaden 1977; Inoue 1983; Yokota 1990; Catling & Sheviak 1993).

The majority of the genera listed by Dressler (1993), are very distinct from the Queensland taxon, a conclusion supported by examination of line drawings and colour illustrations of numerous taxa of Orchideae (for example Luer 1972, 1975). A comparison with the Orchidoid flora of New Guinea and Indonesia, where the genera *Habenaria*, *Peristylus* and *Platanthera* are represented, provides no solution to the problem.

Emphasis has been placed by some authors on the shape and orientation of the root tubers (see for example Inoue 1983), but a scan through the literature and experience with Australian and New Guinea species of Habenariinae, shows this character to be extremely variable and of limited taxonomic application. Some of the characters of the new taxon, in particular the elongated root tubers and undivided labellum, are similar to species in some sections of the genera *Platanthera* (Ogura 1953; Inoue 1983) and *Peristylus* (Seidenfaden 1977). In both of these genera, however, the flowers have a labellum spur.

Thus the new Queensland taxon has uncertain generic and subtribal placement. The options are to accomodate it in a new genus or to place it in an existing genus in which it does not sit comfortably. Opinions as to its placement are divided evenly among the eight orchid specialists who have read drafts of this paper. Although a judgement on its taxonomic placement is hindered by its unusual sexual elements and the taxonomic and nomenclatural confusion that exists within the tribe Orchideae, its local abundance and relative uniformity shows that it is an extremely interesting taxon worthy of recognition and further study. Because I cannot reconcile the general habit of the plant and its unusual floral morphology with any known genus, I have decided to recognize it as a new genus.

Materials and methods

This study is based on the examination of fresh flowers and spirit-preserved specimens collected from localities in north-eastern Queensland. Herbarium collections were examined from AD, CANB, MEL, NSW and QRS. Measurements given in the description are from living plants. Habitat details were supplied by Lewis Roberts. Samples of fresh flowers were examined in a Cambridge Instruments S360 scanning electron microscope using an Oxford CT1500 Cryo Preparation System with the sample maintained at –18° C throughout the viewing operation.

Taxonomy

Cooktownia D.L.Jones, **gen. nov.**

Herbae tuberosae terrestres. Tubera elongata, radicibus similia. Folia 2, basalia, longitudine latitudinem fere aequanti, prostrata, ad basin arcte imbricata. Scapus gracilis, filo metallico similis. Bracteae steriles et fertiles arcte vaginantes. Ovarium cylindricum, attenuatum. Flores virides atro-striatae, non vel tarde aperientes. Sepalum dorsale anguste ovato-ellipticum, ad apicem cymbiforme, marginibus incrassitis. Sepala lateralia ovato-lanceolata, ad apicem cymbiformia. Petala ovato-lanceolata, marginibus pallidis. Labellum anguste obovatum, integrum, sine calcari. Organa sexualia abortiva, atro-viridia. Anthera discreta, sine polliniis. Stigmata discreta. Capsulae anguste ovoideae, rectae.

Typus: *Cooktownia robertsii* D.L. Jones

Tuberous terrestrial herb. Tubers elongate, root-like. Leaves 2, basal, nearly as broad as long, prostrate, the bases closely imbricate. Scape slender, wiry. Sterile bracts closely sheathing. Fertile bracts closely sheathing. Ovary cylindrical, apex attenuate. Flowers green with darker lines, remaining closed or opening tardily. Dorsal sepal narrowly ovate-elliptical, margins thickened, apex cymbiform. Lateral sepals ovate-lanceolate, apex cymbiform. Petals ovate-lanceolate, margins pale. Labellum narrowly obovate, entire; spur absent. Sexual organs abortive, dark green. Anthers free, lacking pollen. Stigmas free. Capsules narrowly ovoid, erect.

The new genus belongs in the subfamily Orchidoideae, tribe Orchideae, but its subtribal placement is uncertain. Only one species is known.

Etymology: The generic name is derived from the nearest main population centre, the historic town of Cooktown which was settled near where Captain James Cook had earlier effected repairs to the barque Endeavour after it struck the coral of the Great Barrier Reef in June 1770.

Cooktownia robertsii D.L. Jones, **species nova**, *Platanthera papuanae* Schltr. affinis, a qua foliis basalibus arcte subimbricatis orbicularibus, floribus apomictibus, labello calcari carente, et columna abnormali staminodiis et stigmate discreto differt. **Typus:** Australia. Queensland. Cook District: c. 3 km north of Mt Misery, 1 April 1993, *C.H. Broers* 441 & *L.J. Roberts* (holo: CANB; iso CANB, BRI, NSW, MEL).

Tuberous terrestrial herb. Tubers elongate, 4–6 cm x 6–8 mm, root-like. Leaves 2, ovate to broadly ovate-orbicular, 1.3–3 cm × 0.8–3 cm, basal, ground-hugging, the bases closely imbricate, dark green, entire, acute to subacute. Scape 15–26 cm tall, slender, wiry. Sterile bracts 3, 9–15 mm × 3–3.5 mm, lanceolate, closely sheathing. Fertile bracts ovate to ovate-lanceolate, closely sheathing. Ovary 12–15 m × 2–3 mm, apex, attenuate. Flowers 3–9, green with darker lines, c. 7.5 mm long, remaining closed or the perianth segments spreading tardily. Dorsal sepal narrowly ovate-elliptical, 6–7 mm × c. 2.5 mm, margins thickened, apex cymbiform. Lateral sepals ovate-lanceolate, 6–7.5 mm × c. 2.5 mm, apex cymbiform. Petals 6–7 mm × c. 2.3 mm, ovate-lanceolate, margins pale greenish white. Labellum narrowly obovate when flattened, 7–7.5 mm × c. 2.5 mm, not 3–lobed, margins incurved, apex obtuse to cymbiform; spur absent. Sexual organs incompletely united and not forming a column, dark green. Anthers abortive, remaining free, lacking pollen. Stigmas abortive, longer than wide, remaining free. Capsules narrowly ovoid to narrowly obovoid, 18–22 mm × 3.5–4 mm, erect, apex drawn out. Figs. 3 & 4.

Flowering Period: March to May.

Distribution and habitat: *Cooktownia robertsii* is endemic to northeastern Queensland, Australia, where apparently it is restricted to areas south of Cooktown, between Helenvale and Mt. Poverty and North Mt. Sampson. It grows in small to large colonies amongst grass in open forest at low to moderate elevations (300–500 m.). The plants grow mostly on ridges and slopes, sometimes on very steep hillsides and also at the heads of gullies. The soil is a red stony or gravelly loam derived from decomposed slate.

Affinities: The anomalous floral morphology of *Cooktownia robertsii* makes it difficult to determine its affinities. Often such an anomalous species is spawned from an equivalent, normally reproducing taxon, but no such relationship is apparent here. The genera *Habenaria* and *Peristylus*, both members of the Habenariinae, are recorded from Australia (Clements 1989, Dockrill 1992) but none of these species are even remotely similar to the new taxon. Geographically the closest member of the Orchidinae is *Platanthera papuana* Schltr. from Papua New Guinea (Schlechter 1911–14). This species is readily distinguished from *Cooktownia robertsii* by its single erect petiolate leaf, a ligulate labellum with a basal spur and a normally functioning column.

Population size: *Cooktownia robertsii* has a narrow distributional range over about 12 km between the coordinates 15°45'S, 145°12'E on the northern side of its range and 15°55'S, 145°13'E on the southern side. It occurs in sporadic populations consisting of individuals of mixed ages and is frequently locally abundant. Juvenile plants are common. The population size is estimated to be 10,000–15,000 plants.

Reproductive biology: The population size, mixed age within populations and local abundance all show that *C. robertsii* is vigorous and reproducing freely. Examination of the root system shows clearly that vegetative reproduction does not occur in this species and it is spread entirely by the seed-like structures which are released from the capsules. These apparently germinate freely in the wild (L.Roberts pers. comm.), and at least one juvenile has now been successfully raised from plants cultivated in the collection of the Australian National Botanic Gardens by sprinkling the seed-like stuctures around the base of mature plants.

Developmental embryology: The embryological development of *C. robertsii* was studied by Mark Clements as part of his Ph.D. thesis (Clements 1995), and I am grateful for his input into this section of the paper. The absence of functional pollen and stigmas in this species points to its reproduction being via apomixis. The seed-like structures have the appearance of a normal orchid seed with the embryo being rounded and surrounded by typical clathrate wings. The embryos are uniform in all of the samples studied and are completely different from the type of embryos usually seen in the seeds of other apomictic orchids. In these species, as exemplified by *Caleana minor* R. Br. and *Genoplesium apostasioides* (Fitzg.) D.L. Jones & M.A. Clem., the embryos are notable for their irregular shapes and asymmetric development.

Pollen tubes are absent from the developmental phases of *C. robertsii* and consequently there is no penetration of the embryo sac and fertilisation of the egg cell by male gametes. However, despite this the developmental stages of the embryo appear normal and are consistent at all stages with those of a typical fertilised embryo of the Orchidoideae. Thus a proembryo develops that fills the embryo sac and a linear chain of four suspensor cells grows out into the inner micropyle (Fig 2.1, 2.2). In the sample range studied, which represents many hundreds of individuals from a number of parent plants, the embryos were all uniform and no freaks or multiple embryos were seen. This clearly indicates that *C. robertsii* has successfully developed a very effective and unusual system of apomictic reproduction. In this species apomixis arises from the egg cell itself within the embryo sac. Further studies are needed to clarify the mechanism involved in this form of apomixis.

Notes: Apart from collections associated with this study no specimens of *C. robertsii* exist in any Australian herbaria.

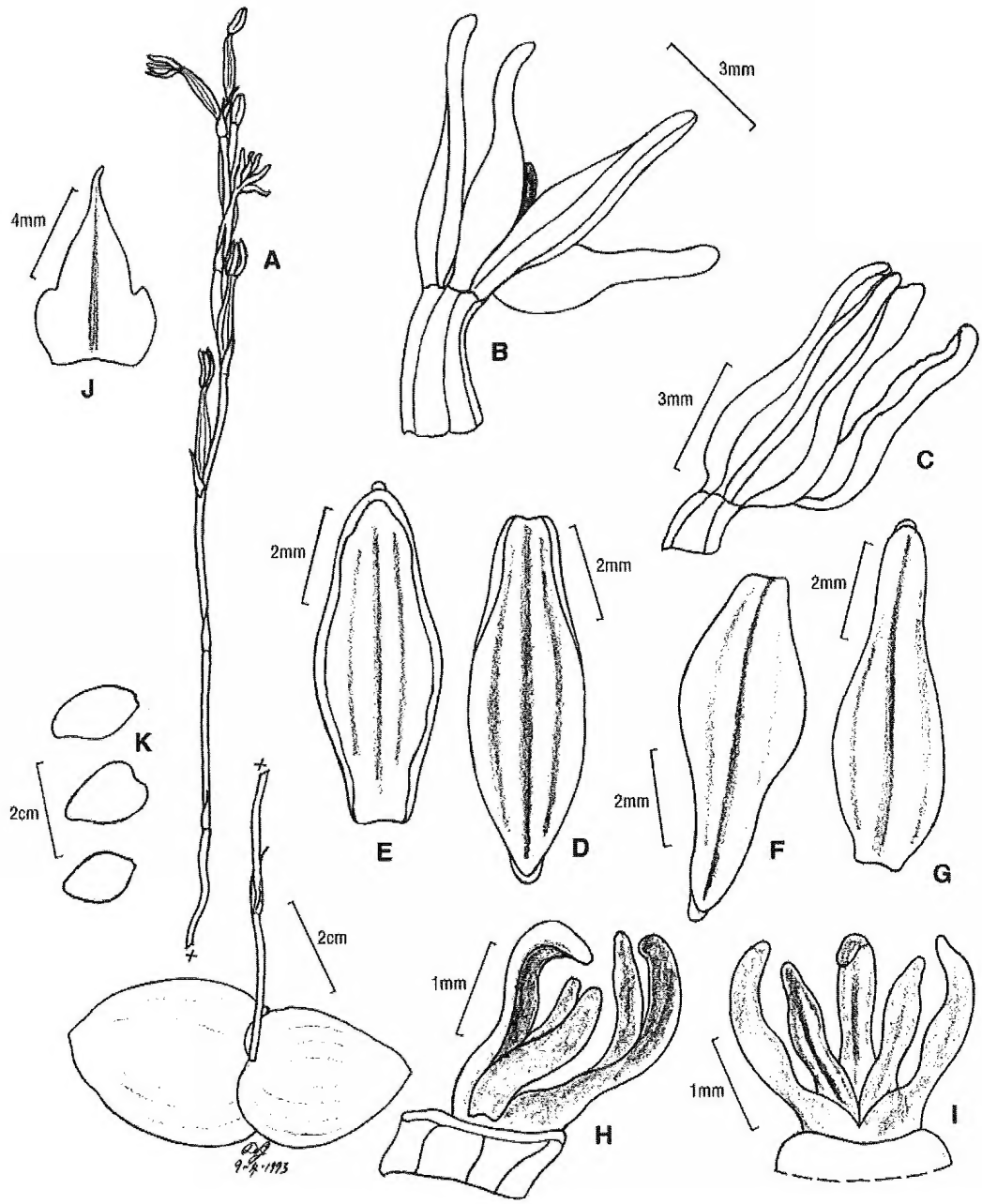

Fig. 3. *Cooktownia robertsii.* a. plant; b. & c. flowers from side; d. labellum from above; e. dorsal sepal; f. lateral sepal; g. petal; h. column from side; i. column from front; j. fertile bract. All from *Broers* 441 & *Roberts.*

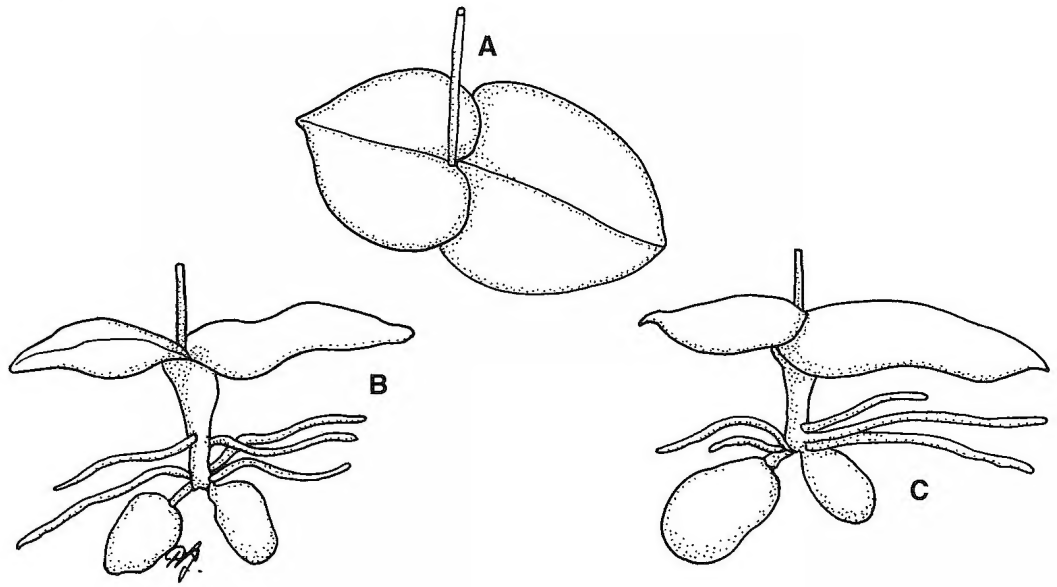

Fig. 4. *Cooktownia robertsii.* a. plant from above showing leaves; b.& c. plants from side showing root system. All from *L. Roberts (ORG 710).*

Additional collection: Stony Ck, 27 Apr 1997, *Roberts* (ORG 710) (CANB).

Conservation status: Although locally common, *Cooktownia robertsii* is restricted to a relatively small area and is not conserved; I suggest a classification 2R by the criteria of Briggs & Leigh (1996).

Etymology: The specific name honors Lewis J.Roberts who discovered the species and recognised its orchidaceous features; he has many notable natural history discoveries, including other new orchids, to his credit.

Acknowledgements

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